CBEA High-Efficiency Troffer Lighting Specification

The U.S. Department of Energy's (DOE) Commercial Building Energy Alliance (CBEA) is driven and managed by key industry partners whose goal is to transform the energy efficiency of commercial buildings. Members of the CBEA Troffer Lighting Team are working to support the increased use of high-efficiency lighting troffers that are reliable, energy efficient, and competitively priced.

DOE's CBEA Project Teams are focusing on reducing commercial building energy costs and consumption by working with a host of industry suppliers, including appliance, heating, cooling, and lighting manufacturers, to meet members' energy-efficiency needs. One area in particular that offers immediate returns is lighting. To date, the CBEA Lighting Project Team has developed specifications for light-emitting diode (LED) site (i.e.,parking lot) lighting, high-efficiency parking structure lighting, and LED refrigerated case display lighting, and high-efficiency troffer lighting (see **www1.eere.energy. gov/ buildings/ alliances/technologies.html**).

In November 2010, the CBEA Troffer Lighting Team was formed to develop technical specifications and establish performance levels for troffer lighting products. In June 2011, the group released a CBEA specification for 2'x2' troffer configurations, and later expanded their specification development focus to include 2'x4' and 1'x4' configurations, which are also prominent applications in commercial buildings. In fact, 50% of all commercial fluorescent lighting fixtures are recessed troffers in 2x4, 2x2 and 1x4 configurations, in operation for more than 10 hours a day on average and collectively consuming more than 87 terawatt-hours of electricity annually.

Photo Credit: Cree LED Lighting

Cree CR22™ Recessed Troffer Using Solid-State Lighting Technology

On February 15, 2012 DOE released the CBEA High-Efficiency Troffer Lighting Specification v3.0 which sets performance requirements for high-efficiency LED and fluorescent troffer products in the 2x4, 2x2, and 1x4 configurations. The group acknowledged rapid improvements in solid-state lighting (SSL) (e.g., LED technology) as an opportunity for increased performance and energy efficiency. While LEDs have a strong potential to meet this specification, other technologies are not excluded because the specification is technology neutral.

DOE Support

DOE provides technical assistance in support of this specification project, including:

- Product performance testing
- Product demonstration technical support
- Analysis of energy cost savings
- Analysis/quantification of maintenance cost savings
- Investigations into life measurements and other performance indicators
- Development and maintenance of the CBEA product performance specification
- Technology specification technical assistance

The specification can be found at **www1.eere.energy.gov/buildings/alliances/technologies.html**.

CBEA Member Opportunities and Benefits

There are several ways CBEA members can get involved in this effort: identifying candidate products, reviewing product laboratory testing, conducting field demonstrations, evaluating candidate products, and installing these products in their facilities. Interested CBEA members benefit from their participation in a variety of ways, including being better informed of the potential of high-efficiency troffers (from DOE research and reports from other members), and being among the first to hear about new and promising technologies, to participating in demonstration projects and purchasing products that meet the specification requirements.

Project Next Steps

- Completing Demonstration projects hosted by CBEA members.
- Sharing product performance among CBEA members and the larger commercial buildings community
- Purchasing and installing troffer lighting products that meet the specification requirements

Energy Savings

If designed and installed properly, high-efficiency troffers that meet the specification can derive energy savings of 15–45% on a one-for-one basis compared to traditional fluorescent troffers, and up to 75% if integrated with dimming, occupant, or daylight controls. In addition to the direct energy cost savings, maintenance costs are reduced because of the need for fewer and less frequent lamp replacements. For the benefits of high-efficiency troffers, see Table 1.

Table 1. Benefits of High-Efficiency Troffers, as Defined in the CBEA Specification

Product Feature	LED	Fluorescent
Efficacy	Less wattage is required to produce equivalent light levels.	
Controls	Inherently dimmable but compatibility should be verified prior to commitment.	Dimmable when mated with a dimming ballast and associated controls.
Environmental Impact	Contains no mercury.	Contains a very limited amount of mercury (less than the amount allowed in fish). Some lead in glass.
Longer Life/Lumen Maintenance	Expected long life of 50,000+ hours, but actual end-of-life performance is not completely understood.	Expected life of 24,000 to 52,000 hours. Actual value depends on ballast plus lamp pairing and controls.

Technical Specification

CBEA Troffer Lighting Team members have developed a specification for 2x4, 2x2, and 1x4 troffers. Key performance parameters of the specification can be found in Table 2. See **www1.eere.energy.gov/buildings/alliances/technologies.html** for the specification.

Table 2. Performance Parameters of the CBEA High-Efficiency Troffer Specification

Performance Attribute	Specification	Notes
Minimum Initial Luminaire Light Output (lumens)	<table><tr><th></th><th>LED</th><th>Fluorescent</th></tr><tr><td>1x4</td><td>2000</td><td>1800</td></tr><tr><td>2x2</td><td>3000</td><td>2700</td></tr><tr><td>2x4</td><td>4000</td><td>3600</td></tr></table>	Differing initial values are due to the high lumen maintenance of fluorescent lamps.
Minimum Luminaire Efficacy (lm/W)	<table><tr><td>1x4</td><td>74</td></tr><tr><td>2x2</td><td>69</td></tr><tr><td>2x4</td><td>74</td></tr></table>	Measured according to IESNA LM-79-2008 (LED) or LM-41-1998 (fluorescent).
Minimum Lumen Maintenance/ Rated Lamp Life	**For LED-based Luminaires**—L_{70} ≥ 50,000 hours **For Fluorescent-based Luminaires**—Rated lamp life ≥ 30,000 hours	**For LED-based Luminaires**—Based upon-L_{70} based upon IESNA LM-80, In-situ Temperature Measurement Test (ISTMT) and IESNA TM-21. **For Fluorescent–based Luminaires**—Rated lamp life based upon rapid-start ballasts with 12-hour operating cycles.
Spacing Criteria (SC)	<table><tr><th></th><th>0°–180° Plane</th><th>90°–270° Plane</th></tr><tr><td>1x4</td><td rowspan="3">1.05–1.40</td><td>1.15–1.80</td></tr><tr><td>2x2</td><td>1.10–1.70</td></tr><tr><td>2x4</td><td>1.15–1.80</td></tr></table>	Spacing criteria is the ratio of fixture spacing to mounting height and establishes the point at which uniform illumination occurs between fixtures at a given mounting height.
Correlated Color Temperature (CCT)	2700K 3000K 3500K 4000/4100K 4500K (LED only) 5000K	Nominal CCTs and tolerances as defined by: **For LED-based Luminaires**—ANSI/NEMA/ANSLG C78.377-2008 "Specifications for the Chromaticity of Solid State Lighting Products." **For Fluorescent–based Luminaires**—ANSI/NEMA/ANSLG C78.376-2001 "Specifications for the Chromaticity of Fluorescent Lamps." Chromaticity tolerances defined by ANSI C78.376 correspond to a 4-step MacAdam ellipse and ANSI C78.377 corresponds to a to 7-step MacAdam ellipse (approximated in the case of C78.377). In addition to the nominal CCTs defined for fluorescent sources, SSL products add a 4500K nominal CCT.
Minimum Color Rendering Index (CRI)	R_a ≥ 80 and R_9 > 0	Equivalent to "800" series fluorescent lamps.
Minimum Warranty	3 years	

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

EERE Information Center
1-877-EERE-INFO (1-877-337-3463)
www.eere.energy.gov/informationcenter

Commercial Building Initiative

For more information, contact:
Linda Sandahl
Pacific Northwest National Laboratory
linda.sandahl@pnnl.gov

A Strong Energy Portfolio for a Strong America
Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

February 2012